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A MACHINE FOR TRIMMING CAMPHOR TREES

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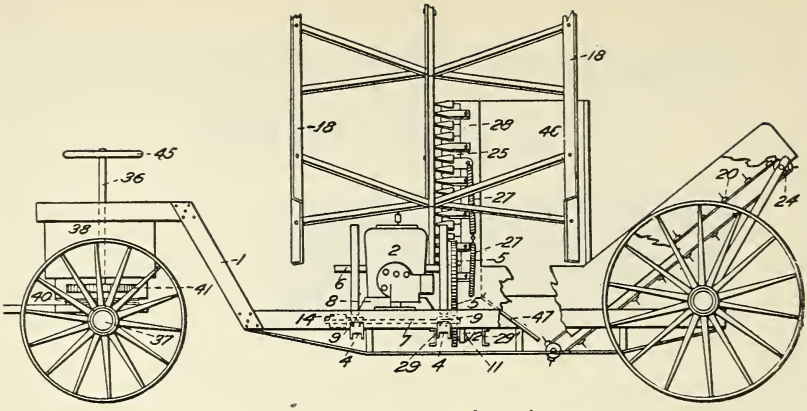

FIG. 1.—Side view of camphor trimmer.

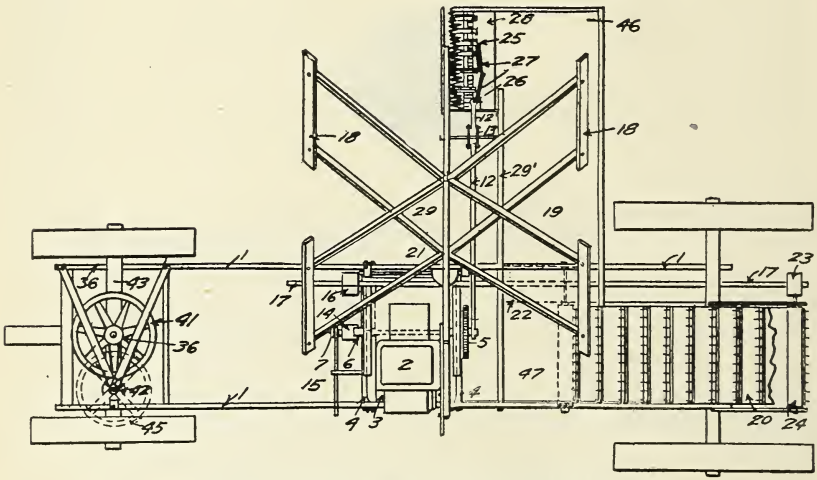

FIG. 2.—Top view of camphor trimmer.

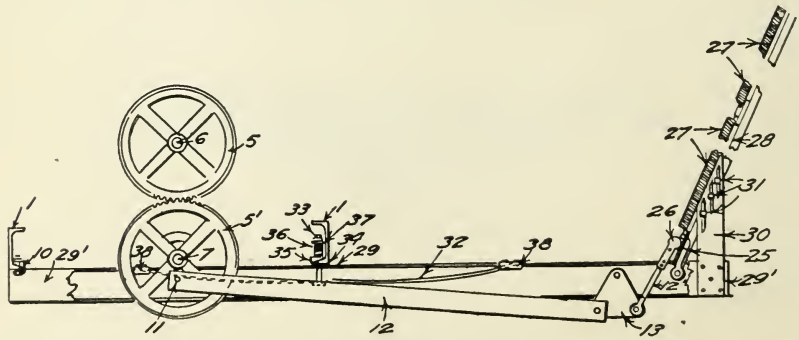

FIG. 3.—View of the mechanism which transmits the power from the engine to the cutting knives of the camphor trimmer.

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MECHANISM FOR HARVESTING CAMPHOR MATERIAL.

The production in the United States of gum camphor from the leaves and twigs of the camphor tree (*Cinnamomum camphora*) has reached a stage where there exists a demand for machinery to replace hand labor in the harvesting operations. The first step in the production of gum camphor after the trees have been established on the plantation is the removal of the new growth of leaves and twigs. At two more or less sharply defined seasons of the year the camphor tree becomes dormant, at which times the leaves and twigs may be removed without injury to the tree. When hand labor is employed to remove this material, which usually consists of small branches of varying diameters, rarely exceeding 1 inch, the cost is found to be excessive. Also, the trees, instead of receiving merely a clipping of the small branches, very frequently receive a severe pruning, which is detrimental to their growth. This severe pruning causes the trees to assume unnatural shapes and destroys the symmetry of the row. It also causes the trees to throw out abnormal growths at the ends of the pruned branches and trunks, thereby making subsequent prunings more and more difficult.

It is an established fact that camphor wood of one or two years' growth contains relatively small proportions of camphor, whereas the leaves contain relatively large percentages. The quantity of wood which is removed by severe pruning is greatly in excess of the leaves. Severe pruning therefore increases the weight and bulk of the green material to be handled in the field and at the distilling plant without appreciably increasing the per acre weight of the camphor obtained. Considerable expense is also incurred in distilling this bulky camphor brush, which does not contain sufficient gum camphor to pay the cost of handling and distilling and of removing the refuse from the stills. Furthermore, it has been demonstrated experimentally that as the camphor tree increases in age

the proportion of camphor in the trunk and limbs also increases. The leaves and young limb growth always contain relatively large amounts of camphor; hence, if only the leaves and new growth are removed each dormant season the remaining old limbs and trunk will be gradually increasing in camphor content, and if at any future time it becomes desirable or expedient to cut down and distill the whole tree the yield of camphor obtained will be large in comparison with the bulk and weight of the green material handled.

The price of labor has gradually increased until the point has been reached where hand clipping, even when done with care so as to preserve the trees and to remove only the best camphor-producing material, has become so expensive as seriously to threaten the profitable production of gum camphor in the Gulf States. Therefore, the problem of meeting this difficulty became one of (1) devising a mechanical means for clipping the leaves and twigs from the camphor trees planted in rows, (2) making the machinery so devised as simple and easy to operate as possible, (3) constructing this machinery in such a manner that the trees would not be injured in clipping, and (4) producing a machine that would clip a large portion of the leaves and twigs available for distillation.

During the winter of 1915–16 such a machine was constructed in the laboratory of Drug, Poisonous, and Oil Plant Investigations at Orlando, Fla. This machine was given a trial in the summer of 1916 at the camphor plantation of the Satsuma Co., Satsuma Heights, Fla. It was decided, however, to be too heavy and cumbersome for mule draft, but the principle on which it was constructed was found to be sound. A second model was constructed during the fall and winter of 1916–17, and trial clippings were made during the summer season of 1917 on the plantation mentioned. This demonstration proved beyond a doubt the practicability of using machinery for clipping camphor trees. The field demonstration was continued throughout the summer season of 1917, over 400 acres of camphor trees being trimmed during that time. From the results of this field demonstration some minor improvements in the design of the machine have been made, but the main principle has not been altered.

DESCRIPTION OF THE MACHINE.

The machine consists of six essential parts, as follows:

(1) A truck fitted with proper framework of iron for the conveyance and support of the operating machinery.

(2) An internal-combustion engine on the framework of the truck.

(3) A cutting frame consisting of supports for the cutter bar and rocker arm, mounted on the framework of the truck and supported by springs which tend to lessen vibration.

(4) A cutter bar held rigidly to the proper angle for cutting, with knives operated by means of gears, pitman rods, and rocker arm connected in the proper manner with the internal-combustion engine.

(5) A reel for whipping the small camphor twigs, branches, and leaves into the cutting blades.

(6) Canvas aprons to convey the severed twigs, branches, and leaves into burlap bags carried at the rear of the truck and to dispose of this material in any manner desired by the operator.

The details of the machine as they appear in side and top views are shown in figures 1 and 2. Figure 3 is a view of the mechanism which transmits power from the internal-combustion engine to the cutting knives, and figure 4 shows the remodeled machine. The numbering of the various parts of the machine is the same in figures 1, 2, and 3.

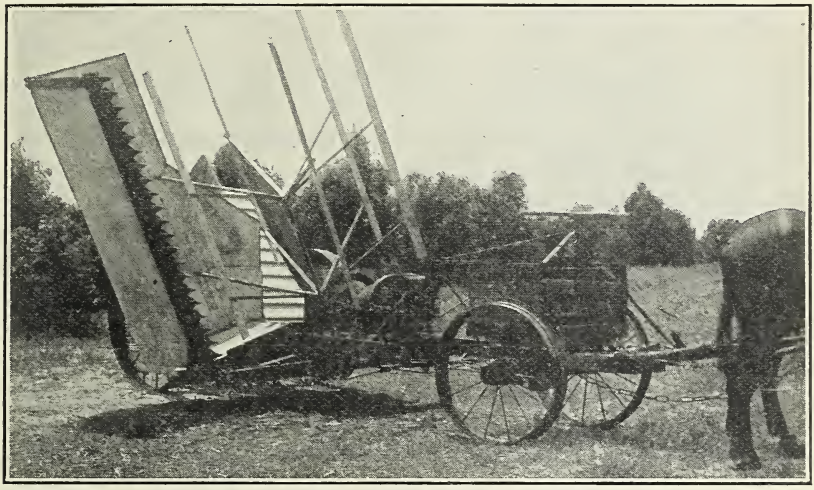

FIG. 4.—Remodeled camphor trimmer.

THE MACHINE TRUCK.

The truck of the machine (figs. 1 and 2) is constructed to meet the needs of the case and consists of 6-inch channel irons built into a framework and carried on four iron wheels having a wide tread. The front of the truck frame (fig. 1) is so constructed that it allows extremely short turns, thus enabling the driver to turn the machine in the space between the rows of camphor trees. An auxiliary steering apparatus is provided, by means of which the operator can hold the machine to a given line of cutting, within a certain limit, irrespective of the direction of the line of draft. With mule draft this provision was necessary, but with tractor draft it is possible to dispense with the auxiliary steering device.

THE INTERNAL-COMBUSTION ENGINE.

An internal-combustion engine (figs. 1 and 2) of suitable power (in this model a 3-horsepower capacity was sufficient) is mounted on the specially constructed truck frame in such a manner that it tends

to balance by its weight the weight of the cutter bar and its frame, which project at the right-hand side of the truck frame. The engine is employed to furnish power to drive the cutting knives, or sickle, the reel, and the canvas aprons.

THE CUTTING FRAME.

The cutting frame of the machine (figs. 2 and 3) is constructed of 4-inch channel irons bolted securely to the left side of the machine truck and extending 3 feet beyond the right-hand side of the machine truck. This cutting frame is supported at the right-hand side of the machine truck by an arrangement of leaf and coil springs (fig. 3), so attached to the cutting-frame channel irons and the machine truck frame that ample rigidity is obtained, and yet the vibration caused by raising and lowering the cutting knives is effectually taken up before it can be transmitted to the machine truck frame. The rear or back channel iron of the cutting frame extends somewhat farther than the front channel iron, in order to give support to an iron plate that holds the cutter bar in position.

The rocker arm is supported on shafting mounted on the cutting frame and is so designed that the power transmitted by the pitman rod connected to the engine can be transferred to the cutting knives by means of a short pitman rod and a ball-and-socket joint. (Fig. 3.) This rocker arm is so designed that the angle of the cutter bar can be moved throughout a range of 10 degrees, that is, from 60° to 70°, without throwing the movement of the cutting knives or blades appreciably beyond the center of the guards. If the angle of cutting, which has been established by trial at about 65°, should be raised or lowered beyond the limits of 60° to 70° a change must be made in the design of the rocker arm and the stroke shortened or increased, as the case may demand.

THE CUTTER BAR.

The complete cutter bar (figs. 1 and 2) is constructed of material heavy enough to resist the usage for which it was designed. The bar proper consists of a 6-inch channel iron tapered to 4 inches at its upper end and with one side of the channel planed smooth. By using a channel iron instead of a flat piece of iron, a bar was provided that was not flexible and was not subject to bending due to its own weight. The sickle guards are made of cast steel and have teeth cut into their edges, over which the sickle moves. These teeth tend to hold the branches of the camphor tree firmly in against the guard until the cutting knife severs them. The cutting knives are made of tool steel and in accordance with the conventional design, differing only in being larger and stronger than ordinary

mowing-machine knives. The whole cutter bar is held at the proper angle (65°) by a plate bolted to the bar and to the back channel iron of the cutting frame. This plate is slotted and so arranged that the cutter bar can be moved through an arc of 10 degrees (that is, from 60° to 70°), and the angle of cutting can thus be changed as occasion demands. The bar must, however, be held rigidly to the angle previously decided upon and can not be moved through the 10-degree arc without first loosening the support bolts; that is, the bar is not free moving throughout this 10-degree arc. The complete cutter bar is hinged at the lower end on a shaft supported by the cutting frame.

THE REEL.

A reel of conventional design (figs. 1 and 2) is employed to whip the leaves and twigs of the camphor tree into the cutting knives. The reel is braced in place at an angle corresponding to that of the cutter bar, but is entirely independent of it, being supported by the machine-frame channel iron and suitable bracing and being driven by a shaft and gears carried on the machine frame. At the right-hand side of the machine frame a shaft is run, extending the entire length of the machine. A gear wheel mounted on this shaft meshes with a gear wheel bolted to the reel shaft, and the reel is driven at the proper speed by this gear arrangement. A reel was found to be necessary in order to prevent small branches and twigs from being pushed down by the cutter bar without being severed by the cutting knives. The reel also answers another purpose by carrying the severed branch beyond the cutter bar. The blow of the reel carries the branch against the knives, where it is severed, and at the same time carries it some inches beyond the cutter bar, where it is deposited on a canvas chute provided for the purpose.

THE CANVAS APRONS.

At the back of the cutter bar a canvas chute (figs 2 and 3) is provided, which catches the cut branches and leaves as they come from the cutting knives. The severed material slides down this chute and falls into a moving apron (fig. 2), which carries it up to and over the right-hand side of the machine frame and dumps it into a hopper. Here the cut material, consisting of small limbs, twigs, and leaves of camphor, is caught up by another canvas apron and elevated into a container carried by the machine or dumped into a trailer wagon. The aprons are driven by the same shaft that drives the reel, and the shaft is driven by a belt connection with the internal-combustion engine. The lower apron (fig. 2, *19*) is driven by a roller (fig. 2, *22*) directly connected to the shaft, and

the elevating apron is driven by means of a belt and rollers in the usual manner.

OPERATING THE MACHINE.

The angle of cutting (65°, for example) having been determined and the line of cutting having been decided upon, the operation of the machine is as follows: The internal-combustion engine is started, and simultaneously the cutting knives are also put in motion. A clutch (fig. 2, 7) is then thrown in and the reels and aprons begin to move. The driver of the draft mules and the man at the steering wheel then keep the machine moving forward, following the line of cutting as closely as possible, using the eye as a guide. As the machine moves forward down the row of camphor trees planted in hedge formation, the reel revolving at a suitable speed whips the small branches and twigs into the cutting knives, where they are severed. At the same time the force of the blow struck by the reel carries the cut branches beyond the knives and deposits them on the canvas slide. Here the cut branches slide down the canvas chute to the base line of the cutter bar and are there picked up by the moving apron and carried into the hopper. A second apron operating at right angles to the first apron picks up the leaves and twigs and deposits them in suitable containers ready for transportation to the distilling plant.

The operation of the machine is not difficult, requiring only the necessary attention and care given to any similar farm machinery. Three men are expected to operate the machine when mules are employed, but it is believed that two men will be able successfully to operate machines driven by tractors. Such machines are now under construction by private interests, and their construction is based on the results obtained by the experimental machine described in this bulletin.

This camphor-trimming machine was constructed by the United States Department of Agriculture, and a patent has been applied for which will contain a proviso dedicating it to the use of the public.

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